



YOUR GUIDE TO
Heat Pump
Water Heaters



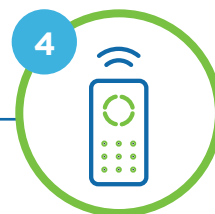
LOWER GREENHOUSE



COST



DEHUMIDIFIES



SMART
CONTROLS

Heat pump water heaters are an efficient hot water system that transfers heat from the surrounding air to heat your home's water without burning fossil fuels.

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Heat Pump Water Heater (HPWH)

Technology Overview

A Heat Pump Water Heater (HPWH) is a hot water heater that transfers heat from the surrounding indoor air (or the outdoor air, if the HPWH is connected to the outdoors by vents) into a hot water tank, which is typically located in an open, unfinished basement or garage. This heated water is then piped throughout the home to showers, dishwashers, sinks, and washing machines. Because heat is transferred instead of generated (i.e., by burning fossil fuels or using an electric resistance tank), heat pump water heaters can be three times more efficient than conventional water heaters.

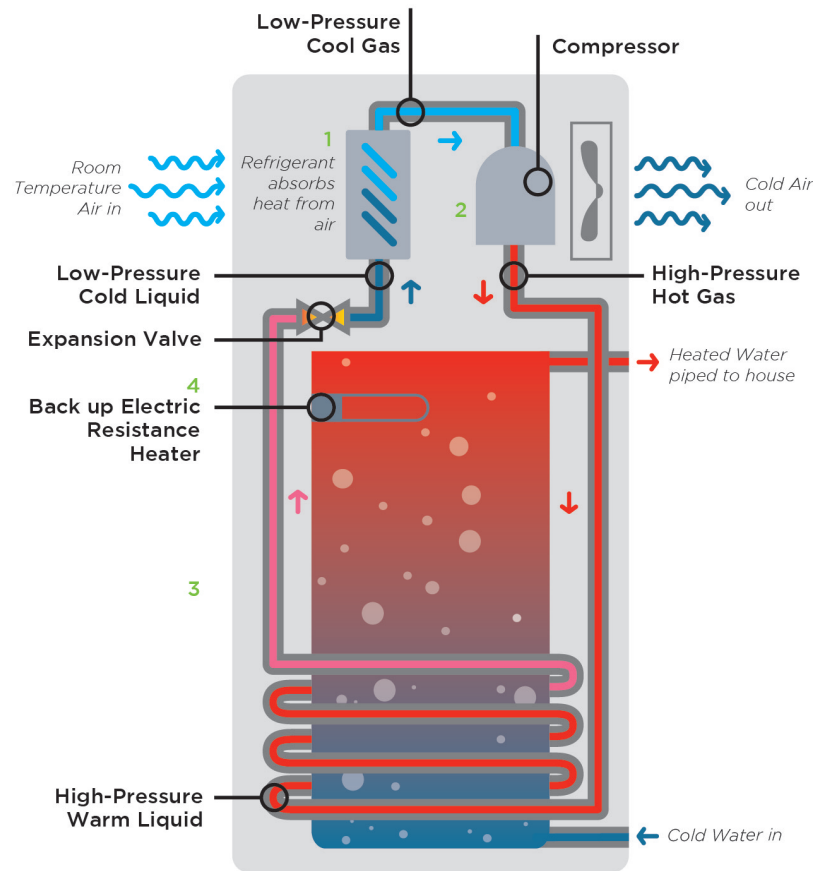


Heat Pump Water Heater



HEAT PUMP WATER HEATER (HPWH)

The Technology



A heat pump water heater has two primary components: a heat pump, which absorbs heat from the surrounding air, and an insulated storage tank, which stores heated water for later use. To heat water, (1) a fan draws air from the surrounding space across a coil filled with cold, low-pressure refrigerant. The refrigerant absorbs heat from the air and is compressed (2) into a hot vapor. Coils containing the heated refrigerant wrap around the hot water tank, transferring heat into the stored water (3). Once the refrigerant loses heat and has condensed back into a liquid, the process repeats. If the heat pump can't meet the hot water heating needs of the home (due to high usage or the space becoming too cold for sufficient heat absorption), backup electric resistance elements (4) can boost the temperature of the water as needed.

By pulling heat from the surrounding air, heat pump water heaters also provide dehumidification to the space in which they are located. Just how much dehumidification the system can offer depends on how much hot water a household uses: the more the system is used, the more heat and humidity it will pull from its surroundings. For this reason, most Massachusetts homeowners prefer to install heat pump water heaters in unfinished basements, saving energy due to more efficient hot water heating and reduced dehumidifier usage—though a heat pump water heater won't entirely replace your dehumidifier.



HEAT PUMP WATER HEATER (HPWH)

The Technology

MEASURING EFFICIENCY:

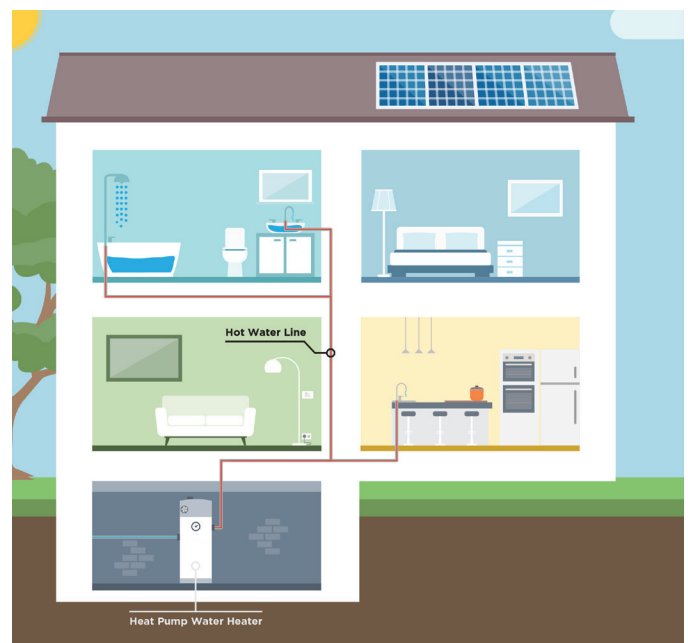
One of the primary metrics of a water heater's performance is its Uniform Energy Factor (or UEF)*. The UEF is a measure of how much water a system of a certain size can heat in a given time period relative to how much energy it uses. The higher the UEF, the more efficient the water heater. Heat Pump Water Heaters generally have a UEF between 2.2 and 3.5+, compared to UEFs of 0.6-0.95 for conventional water heaters.

**Older water heaters may just have Energy Factor (EF) listed on labels. UEF is a new metric developed in 2015 that more accurately reflects water heating efficiency by incorporating standby losses.*

Just like traditional electric resistance water heaters, heat pump water heaters come in a variety of sizes to meet a home's annual domestic hot water needs—typically 50, 65, and 80 gallons. Some heat pump water heaters require a few more inches of vertical clearance than a traditional tanked hot water heater. If you currently have an electric resistance water heater, HPWHs can use the same hookups and electrical connections and you will be able to transition to a HPWH without an electrical upgrade. If you are using a different fuel source to heat your hot water now and have a 100 amp electric panel, talk to your installer to see if an electrical upgrade is required. The heat pump water heater will also likely need access to a floor drain or pump for managing condensate buildup.

Home Improvement Scenarios that work with heat pump water heaters:

- Existing home, replacing hot water system
- Existing home, replacing heating system that also heats hot water
- Existing home undergoing major renovations
- New home construction



ADDITIONAL RESOURCES:

- The Northwest Energy Efficiency Alliance maintains an [Advanced Water Heating Specification](#) that tests HPWHs for their efficiency in cooler climates like the Northeast. Tested products are categorized by tiers based on efficiency and additional features, including holding a 10-year warranty, reduced noise levels, and reduced usage of less efficient electric resistance backup. Check out the [Qualified Products List](#) for more information on what products might best meet your needs.



HEAT PUMP WATER HEATER (HPWH)

The Technology

ADDING DUCTS TO A HEAT PUMP WATER HEATER:

Heat pump water heaters use the heat in the air around them to heat water, cooling and dehumidifying the space they are in. While this can be beneficial in the summer months, it can make spaces like basements less comfortable in the winter. With many models, homeowners have the option to have ducting kits installed, which will allow the heat pump water heater to vent cold exhaust air to the outdoors (or a different room in the home) and/or bring in air from outdoors.

Ducting can be a valuable option for some homeowners, for example in cases where the space your water heater is installed in is too small for sufficient air circulation—or if it is beneficial to bring in air from a warmer room/blow cold exhaust air into another area. Some homeowners may want to blow cold air into a pantry to keep it cool or into an attic or crawl space to keep the basement from getting too cold.

However, in Massachusetts, ducting with the outdoor air entails seasonal considerations. Bringing in outdoor air will only work during the summer where warmer air can potentially improve the performance of the system; during colder months, the intake air will be too cold to allow the heat pump water heater to operate. Ducting cooled air outdoors and not ducting air back in will depressurize your home, increasing air infiltration from the outdoors, which can reduce comfort.



Split Heat Pump Water Heater - Outdoor Unit

SPLIT HEAT PUMP WATER HEATERS:

While most HPWHs available in the US today have the heat pump co-located with the hot water tank, split systems are also becoming available. Split systems include an indoor hot water tank and an outdoor compressor unit connected by refrigerant lines. The outdoor compressor heats the refrigerant by pulling heat from the outdoor air. Some outdoor units use an exterior metal panel that can absorb solar radiation to assist in heating the refrigerant; these types of systems are called solar-assisted heat pumps. The heated refrigerant then passes indoors and heats the water in the hot water tank before returning to the outdoor system. Split- and solar-assisted heat pump water heater systems do not impact indoor air temperatures nor require condensation draining but are subject to weather-based variability in performance based on outdoor air temperatures or daylight. These two kinds of split water heating systems are typically more expensive to install but are well-suited to the unique requirements of some homes. These systems are beginning to be available in Massachusetts, but are still only offered by certain installers.



Solar-Assisted Heat Pump Water Heater - Outdoor Unit



Split Heat Pump Water Heater - Indoor Unit





HEAT PUMP WATER HEATER (HPWH)

Is a HPWH a Good Fit for My Home?

If you answer yes to ANY of the following questions, then a heat pump water heater may be a good fit for your home.

☐ **Do you use an oil, propane, or electric resistance water heater?**

With today's energy prices, using a heat pump water heater instead of an oil, propane, or electric resistance water heater will provide the greatest energy savings.

☐ **Do you want to reduce your home's greenhouse gas emissions?**

Heat pump water heaters run on electricity instead of burning fossil fuels to heat your hot water, reducing your home's greenhouse gas emissions.

☐ **Is your existing hot water tank over 10 years old or reaching the end of its useful life? Has it had maintenance issues or are you concerned about it failing?**

Consider replacing your water heater before it fails or leaks all over the floor. A heat pump water heater can replace your existing water heater, and the installation can be done by a plumber.

☐ **Do you have solar photovoltaic (PV) panels on your roof?**

Heat pump water heaters run on electricity. If you already have PV panels on your roof that are generating more electricity than your home is currently consuming, then you can use the electricity from your existing solar panels to run your HPWH, decreasing or even eliminating your water heating expenses.

☐ **Do you have a basement with at least 750 cubic feet of open space that stays above 50°F year-round?**

Heat pump water heaters need to be located in a minimally warm area with enough open space for air circulation to operate efficiently. Heat pump water heaters will not perform efficiently if placed in mechanical closets: insufficient air circulation and cold basements can lead to higher use of electric resistance backup heating, reducing efficiency and energy savings. Heat pump water heaters will cool the spaces in which they're located, so most Massachusetts homeowners choose to install them in unconditioned basements.



Heat pump water heater ductwork for air intake and exhaust

☐ **Are you considering replacing a combination boiler with an air- or ground-source heat pump for space heating?**

If your old boiler will only be running for water heating, consider replacing it with a heat pump water heater to allow you to remove your old boiler entirely and save on energy.



HEAT PUMP WATER HEATER (HPWH)

Case Studies



Photo courtesy of T. Jagodnik

Bolton resident Tony Jagodnik replaced an aging electric resistance tank in his home with a heat pump water heater. Tony measured the electricity usage of his water heaters before and after replacement and found that water heating electricity usage dropped from 8 kWh/day to approx. 3 kWh/day (not counting savings from nearly eliminating dehumidifier usage), translating to savings of nearly \$400 per year. The heat pump water heater paid for itself in less than five years and helped Tony and his family continue their journey towards minimizing household greenhouse gas emissions. Despite replacing his old oil furnace with a heat pump three years into owning the system (and eliminating a source of waste heat in his basement), Tony has reported that his basement remains stable around 62°F when unconditioned.



HEAT PUMP WATER HEATER (HPWH)

Benefits of Heat Pump Water Heaters

COST SAVINGS

- Operating costs can be up to 50% lower than the operating costs of an electric, oil, or propane water heater.
- This means a heat pump water heater can reduce annual water heating costs \$200-\$400 per year or more, depending on how much hot water you use.
- Heat pump water heaters are robust, and can last much longer than conventional water heaters, with standard warranties for many HPWHs lasting 10 years or more.

FLEXIBILITY AND FUNCTIONALITY

- Many heat pump water heaters have Wi-Fi control, automated leak detection, and other integration features that enable you to remotely control and monitor your water heater.
- Heat pump water heaters provide dehumidification in the spaces in which they are installed (though they typically do not entirely replace dehumidifiers).
- HPWHs can be installed in most places that any other hot water tank could be installed, although they may require a few extra inches of clearance and adequate space for air circulation.

GREENHOUSE GAS EMISSIONS

- Using a HPWH results in lower greenhouse gas emissions than using a traditional electric resistance or fossil fuel water heater. Plus, with today's electric grid getting greener over time, emissions will decrease as time goes on.
- HPWHs offer the potential for zero greenhouse gas impacts when paired with solar PV or 100% renewable electricity.





HEAT PUMP WATER HEATER (HPWH)

Cost, Incentives, & Financing

COST

Heat pump water heaters typically cost between \$2,300 and \$4,300, including installation. The cost to install a heat pump water heater in your home will depend on the specifics of your home, whether you need an electric service upgrade, and your home's hot water load.

Homes that have less than 200-amp electrical service or lack sufficient panel space will likely incur additional costs for upgrading the electrical service or panel to accommodate a heat pump water heater. If you are planning on upgrading your electrical service for a heat pump water heater, make sure to tell your electrician if you are also considering installing other electric appliances in the future (e.g. air or ground source heat pumps, electric vehicle chargers). Additionally, if you don't have a floor drain for removing condensed moisture, you may need to install a condensate pump to move moisture to an appropriate drain.

As you consider the upfront cost, keep in mind that the operating costs (i.e., your monthly energy bills) of heat pump water heaters can be as much as 50% lower than a conventional electric, oil, or propane water heater. Homeowners replacing electric resistance water heaters will typically see higher savings than those replacing oil or propane water heaters.

INCENTIVES

Several incentives are available to homeowners in Massachusetts wishing to upgrade their hot water system to a heat pump water heater. Incentives depend on the kind of system installed and the size of the system. Depending on your electricity provider, you may be eligible for different incentive programs.

- **Mass Save Rebate:** Homeowners replacing an existing electric storage tank water heater or building a new home are eligible for a rebate.
 - Smaller heat pump water heaters (55 gallons or less) with a uniform energy factor (UEF) of 2.0 or higher are eligible for a rebate of \$600.
 - Larger heat pump water heaters (55 gallons or more) with a uniform energy factor (UEF) of 2.7 or higher are eligible for a rebate of \$150.
- If you are served by a municipal electric company, visit your electricity provider's webpage to see if it offer incentives for heat pump water heaters.

ENERGY STAR Equipment Tax Credit: This tax credit of \$300 is available for homeowners installing certified heat pump water heaters with a Uniform Energy Factor (UEF) of at least 2.2.

Note that this federal tax credit expires in December of 2021 and is separate from the investment tax credit for solar and geothermal systems. See the [IRS website](#) and/or consult your tax advisor to confirm eligibility.

FINANCING

- **Mass Save® Financing:** If you are located in Mass Save® territory, qualifying heat pump water heaters can be financed through the [Mass Save® HEAT Loan](#), which offers loans of up to \$25,000 at 0% interest over terms of up to 7 years. To qualify, your house or building must have received a Mass Save home energy assessment within the last two years. If unsure whether you are eligible for Mass Save incentives and financing, check on the [Mass Save® website](#).
- If you are not eligible for Mass Save incentives, check with your local municipal electricity provider to see whether they have any financing options available for hot water systems.



HPWH Incentives are available at the city, state and federal level.



HEAT PUMP WATER HEATER (HPWH)

Making the Switch



- 1. Confirm that heat pump water heaters are the right fit for your home and your home clean energy priorities**
- 2. Understand the costs and plan how you will finance the project.** Check out the [Cost and Incentives and Financing sections](#) of this guide to understand the typical costs to install a heat pump water heater.
- 3. Contact installers.** MassCEC recommends contacting at least three installers to learn more about installing heat pump water heaters in your home. Installers may also give multiple quotes for different installation or unit configurations so you can understand all your options. Visit our [Find An Installer Near You Page](#) for a list of installers. Referrals from family, friends, or neighbors are another great way to find installers. Consider also visiting a hardware retailer that sells and installs heat pump water heaters.
- 4. Prepare your home.** If necessary, take preliminary measures to get your home ready for a new water heating system, such as upgrading your electrical service (if necessary). While a heat pump water heater will save you money on your water heating bill, it won't fix any issues you currently have with your plumbing that result in slower delivery of hot water.
- 5. Install a heat pump water heater.** Talk to your installer about how long installation will take. Heat pump water heater installations can typically be done in a day, depending on need for electrical work.



HEAT PUMP WATER HEATER (HPWH)

How Can I Prepare for a Heat Pump Water Heater?

Determine whether your home has adequate electrical service for a heat pump water heater and make an upgrade if necessary.

Most heat pump water heaters require 15-30 amps of current from your electric panel. If you haven't been using an electric water heater or your home has 100-amp electrical service, lacks space on the panel, or has no 240-volt connection for the water heater, talk to a heat pump water heater installer about whether you may need to upgrade your electrical service to accommodate a heat pump water heater.

Check out [TheSpruce.com](https://www.thespruce.com) for instructions on how to determine the amperage of your home's electric service. [This Old House](#) also has a helpful video that shows what an electrician will do to upgrade your electric meter and panel. Upgrading your home's electrical service is a good investment if you might install an electric vehicle charger, air source heat pump, or other new electrical appliances in the future. This upgrade typically takes one day to complete, and usually costs around \$2,000 to \$3,000, which may include fees and permitting from your local permitting agency. Upgrading your home's electrical service requires a licensed electrician who will coordinate with your electric utility and your local permitting agency.

Think about where your water heater is placed.

- **Size and location:** Some heat pump water heaters (esp. 80 gallon models) are slightly taller than conventional storage water heater to accommodate the fan and heat pump unit. Depending on the tank size and model, HPWHs are typically 60 - 70 inches tall (5 to 6 feet) so check if there an extra foot or two between the top of your current water heater and the ceiling of the room the water heater is in.
- **Air flow and temperature:** The heat pump water heater will need at least 750 cubic feet of open space (i.e., a 10 ft x 10 ft room with a 7.5 ft ceiling height) to have sufficient air to absorb heat. Most systems are also designed to operate efficiently in ambient temperatures of between 50 - 90 °F, so it is important to ensure they are situated in a place that is protected from the extreme cold. Heat pump water heaters can also take advantage of the waste heat given off by a fossil fuel boiler or furnace; consider placing your heat pump water heater next to these appliances. Additionally, the heat pump water heater will cool and dehumidify the space it is in. Venting cold air outdoors or into another part of the home can be an option with many models.
- **Condensation management:** The heat pump water heater will be installed with a condensate pan that will need to be connected to a drain. If a nearby floor drain is not available, a condensate pump to an appropriate drain may be necessary.
- **Noise and vibrations:** Heat pump water heaters are often noisier than conventional water heaters—roughly as loud as a modern dishwasher or refrigerator (approx. 50 decibels), so they may not be appropriate to place near bedrooms or office spaces.



Installation can be conducted by your preferred plumber



HEAT PUMP WATER HEATER (HPWH)

Questions to Ask Your Installer



During your conversation with installers, consider asking the following questions:

CONFIGURATION

What size water heater tank do I need?

You can probably replace your existing water heater with a heat pump water heater of the same size, but you should ask your installer if your current water heater is over- or undersized for your home's hot water load. If you are in between sizes, larger heat pump water heaters tend to provide more efficient performance. A good rule of thumb is that each member of a household will use roughly 20 gallons of hot water per day.

Do I have enough space for a heat pump water heater?

Heat pump water heaters need at least 750 cubic feet of air to efficiently heat water, e.g. a 10' x 10' room with a 7.5 ft ceiling. If you lack sufficient space, or if you can only place the HPWH in a mechanical closet, you may need to add louvers to the closet door and/or vent the exhaust to another part of the house or outdoors to avoid cooling the space off too much and reducing efficiency.

Where will the condensate drain go?

Heat pump water heaters require access to a drain to manage condensate buildup. If a nearby floor drain is not available, a condensate pump to an appropriate drain may be needed.

QUESTIONS TO ASK YOUR INSTALLER (CONT.)

How will the controls be set up? Will it have Wi-Fi integration? Will it have leak protection?

Ask your installer to explain the controls for your system and what additional features are available. While HPWHs work best when left to operate on their own, it is important to know how to adjust your system's settings to meet your household's needs. Many HPWH also have Wi-Fi integration which allows for remote control of the HPWH through your smartphone or other digital device. It also enables alerts, service warnings, and more active monitoring of the system. Leak protection systems are also increasingly common, automatically shutting off water or sealing up areas surrounding a leak to prevent flooding.

COST

What is the installation price and what incentives may be available? Who will apply for these incentives?

Make sure that you understand upfront who will apply for any incentives that you are pursuing and when you need to apply (before vs. after installation).

Aside from annual electricity costs, what other annual costs can I expect (such as regular maintenance or parts)?

Heat pump water heaters use air filters that should be cleaned periodically by the homeowner to ensure efficient operation.

QUESTIONS TO ASK YOUR INSTALLER (CONT.)

TIMING

How far in advance can we plan the installation, and how long does the installation take?

Be sure to communicate if you have particular time constraints and get a sense when your installer will be available to do the installation. If your water heater has failed, you may have more limited options for an immediate heat pump water heater replacement.

A heat pump water heater can often be installed by a professional, and an old unit removed, in the span of 3-5 hours. Ducting, difficult-to-access spaces, and other factors may increase the time needed to complete an install.

What should I do to prepare for the installation?

Make sure you understand from your installer if there is anything you need to do to prepare to have them working in your home.

Will I need an electrical upgrade?

If you live in an older home or lack space on your electrical panel, your home may need an electrical upgrade to ensure it can access enough power to support the heat pump water heater. If you are replacing an old gas, oil, or propane heater, be sure to check with an electrician and your installer to ensure that your home has enough electrical capacity to support the load from the HPWH. If you are replacing an existing electrical system, you don't need to worry about an upgrade. If you do need an upgrade, be sure to work with a licensed electrician to conduct the upgrade.

QUESTIONS TO ASK YOUR INSTALLER (CONT.)

QUALITY ASSURANCE

Do you provide a warranty for the systems you install? What are the different warranty options?

Make sure you understand what is covered by any warranty offered by your contractor (i.e., equipment, labor, or both). Many heat pump water heaters come with a 10-year warranty.

Have you participated in manufacturer training for the systems you would install, and can you provide references from previous customers?

As with any home improvement project, it is important to ensure that your installer has the right training and a good track record with past customers.

Will you hire subcontractors to complete portions of the project? If so, what will they do? What are the names of these companies and how long have you worked with them?

Many heat pump water heater installers sub-contract the electrical work. Some will even allow the homeowner to select their own electrician.

Will you provide training for me on how to properly operate and maintain the system (i.e., thermostat settings, cleaning air filters.)?

Heat pump water heaters are relatively simple to operate, but there are a few differences compared to other water heating systems, and your installer should be a good educational resource. Heat pump water heaters use air filters that should be cleaned periodically to ensure efficient operation.



HEAT PUMP WATER HEATER (HPWH)

Getting the Most from Your New System

OPERATION

- Set the water heater as low as you are comfortable. The cooler the water is in the tank, the less heat will escape, and the more efficient the system will be. 120 °F is often a good base temperature.
- Avoid changing the settings on your heat pump too frequently. Changing the temperature settings, especially increasing the set temperature, will cause the system to work overtime, decreasing the system's efficiency. Once you have found a comfortable temperature setting the best way to manage your HPWH is to leave it alone.
- Use the "Heat Pump (only)" mode whenever possible to ensure you are maximizing the use of the heat pump system, rather than the electric resistance backup.
- Many heat pump water heaters will have a "vacation" mode that should be used during extended absences to keep the system functional but significantly diminish energy use.

HOMEOWNER MAINTENANCE

- To keep your units operating efficiently, clean or replace indoor air filters ever 2-6 months, depending on how dirty they are. To clean your air filters, simply wipe the filter with a damp cloth, or rinse it under running water and let it dry.
- Some HPWHs even have an indicator showing when the air filter needs to be cleaned. If you see this indicator come on, clean the filter as soon as possible.
- Check the condensate overflow line periodically. If you see water dripping out of the line, you likely have a blockage, and should follow the manufacturer's instructions to clean the line.

PROFESSIONAL MAINTENANCE

- Maintenance requirements for heat pump water heaters are minimal. Nevertheless, it is often advisable to schedule a maintenance check with your heat pump water heater installer every few years (or at the installer's recommended interval) to make sure that everything is running smoothly.



Talk with your installer to learn how best to operate your heat pump water heater



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